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PETROLOGY.—*Magnetite basalt from North Park, Colorado.*[1] H. S. WASHINGTON and E. S. LARSEN. Geophysical Laboratory and Geological Survey.

The rock described in this paper was collected by A. L. Beekley of the United States Geological Survey, to whom the authors are indebted for the material and for the description of its occurrence. The specimen was collected at the top of Pole Mountain in North Park, Colorado, about three miles southwest of Coalmont. The summit of Pole Mountain is a small remnant of the Tertiary volcanic rocks which are extensively developed on the higher slopes to the south. The outcrops are poor and the material probably represents a breccia. Most of the neighboring Tertiary volcanic rocks are basaltic; but they are rich in soda and in them magnetite is not exceptionally high.

The magnetite basalt is black, aphanitic and very porous; megascopically it shows no determinable crystals. The microscope shows that it is holocrystalline, and is made up of about one-half magnetite, with nearly equal amounts of bytownite and pale green augitic pyroxene, and a smaller amount of apatite. The texture is poikilitic; euhedral crystals of magnetite are rather evenly included in anhedrons of both feldspar and pyroxene. The rock is apparently perfectly fresh. On account of the porosity no determination of the specific gravity was made.

A chemical analysis was made, using the standard methods. All of the major constituents, (except the alkalies,) and also titanium were determined in duplicate, with closely agreeing

[1] Published by permission of the Director of the U. S. Geological Survey.

ANALYSES OF IRON ORE IGNEOUS ROCKS

	A	B	C	D	E	F	G	H	I	J
SiO_2	19.74	21.42	17.90	11.73	26.62	20.30	10.77	7.82	4.08	8.04
Al_2O_3	9.72	7.03	10.23	6.46	11.62	7.60	4.61	3.20	6.40	0.39
Fe_2O_3	39.70	30.34	15.85	30.68	19.50	29.99	39.27	29.40	33.43	88.41
FeO	15.60	22.81	27.95	27.92	21.87	25.65	21.73	29.78	34.58	2.52
MgO	3.70	6.92	6.04	3.35	2.57	3.68	2.34	5.67	3.89	0.06
CaO	6.64	3.59	2.86	3.95	6.47	3.50	4.84	3.42	0.65	0.23
Na_2O	0.46	0.53		0.50	1.06		0.31	0.61	0.29	0.05
K_2O	0.66	0.41		0.26	0.34		0.24	0.17	0.15	0.29
H_2O+	0.32	0.95	1.33	0.64	1.30	1.70	0.44	0.38	1.32	0.17
H_2O-	0.04									
CO_2	none	tr.	0.10	0.32						
TiO_2	0.58	5.21	15.66	12.31	9.50	7.80	13.52	17.23	14.25	0.39
P_2O_5	1.67	0.14	0.01	0.82		0.03	0.02	0.14	0.02	tr.
Cl		0.42		0.12						
S		0.04	0.14	0.04		0.10[2]	0.11	0.06		0.02
Cr_2O_3	none	none	0.51						0.20	
V_2O_3	0.44		0.55	0.04			0.52	0.63		
MnO	0.38	tr.	tr.		0.20	0.34	0.37	0.22	0.45	0.02
NiO	none						0.27	0.43		
CoO							0.07	0.10		
BaO							0.07			
	99.75	99.81	99.15	99.19[1]	101.05	100.69	99.50	99.26	99.71	100.59

[1] Including 0.05 C.

[2] SO_3

A. Magnetite basalt (Arapahite). Pole Mountain, North Park, Colorado. H. S. Washington, analyst.

B. Iron ore. Elizabethtown, Essex County, New York. W. F. Hillebrand analyst. J. F. Kemp, 19th Ann. Rep. U. S. G. S., **3**: 408. 1899.

C. Iron ore. Westport, Essex County, New York. W. F. Hillebrand, analyst. J. F. Kemp, loc. cit., p. 402.

D. Iron ore. Lincoln Pond, Essex County, New York. W. F. Hillebrand, analyst. J. F. Kemp, loc. cit., p. 407.

E. Magnetite rock. Joubrechkine, Wichera, North Ural Mountains. Duparc (?), analyst. Duparc and Pearce, Mem. Soc. Phys. Gen., **36**: 187. 1909.

F. Magnetite rock. Joubrechkine, Wichera, North Ural Mountains. Duparc (?), analyst. Duparc and Pearce, loc. cit., p. 187.

G. Iron ore. Pine Lake, Victoria County, Ontario. F. J. Pope, analyst. F. J. Pope, Trans. Amer. Inst. Min. Eng., **29**: 380. 1899.

H. Iron ore. Horton, Renfrew County, Ontario. F. J. Pope, analyst. F. J. Pope, loc. cit., p. 380.

I. Magnetite spinellite. Routivaara, Sweden. W. Petersson, analyst. W. Petersson, Geol. För. Förh., **15**: 49. 1893.

J. Iron ore. Kiruna, Lapland. G. Nyblom, analyst. P. Geijer, Geol. Kiruna Distr., 1910, p. 177.

results. Titanium was determined (in duplicate) by the colorimetric method, as its amount was small, the color effect of the very large amount of iron being removed by the addition of phosphoric acid, a corresponding amount being added to the standard manganese solution.[2] In a special large portion nickel, chromium and vanadium were tested for. Not a trace of nickel was found with dimethylglyoxime as a reagent. A coloration, possibly due to chromium, was barely perceptible, even when the solution was highly concentrated, and the amount of this cannot be as much as 0.01 per cent, even if present. Vanadium was determined by Hillebrand's method and its presence was verified after the titration. Combined water was determined by Penfield's method. The amount of V_2O_5 was subtracted from that of P_2O_5, as it is precipitated and weighed with the phosphomolybdate,[3] if the latter is in sufficient excess. This is a point to be borne in mind in the analysis of rocks containing notable amounts of vanadium.

The analysis shows some remarkable features and, while nearly all its constituents can be matched in the other analyses of iron ore rocks derived from igneous magmas, it does not correspond in all respects with any of them. One of the Adirondack ores (B) resembles it most closely. It is especially remarkable in the very low titanium, the hematite ore of Kiruna alone approaching it in this respect. The phosphorus is notably higher than elsewhere, while the absence of nickel and chromium is noteworthy. The amount of vanadium is about that of most of the Adirondack and Ontario ores.

The norm of the Colorado basalt is as follows:

Or	3.89	Mt	49.88
Ab	3.67	Il	1.06
An	22.24	Hm	5.28
C	0.10	Ap	4.03
Hy	7.70		98.97
Ol	1.12	Rest	0.80
			99.77

[2] Cf. W. F. Hillebrand, Bull. 422, U. S. G. S., 1910, p. 134.
[3] Cf. J. R. Cain and J. C. Hostetter, Techn. Pap. Bur. Stand., No. 8, 1912.

This places it in the dofemane class and in the domitic order (adirondackore), but transitional to the permitic order, hypersthene and olivine being very low. It is in the permiric rang and perhemic subrang—a position which is briefly expressed by the symbol IV.4(5).1.1. The rang and subrang are as yet unrepresented and unnamed. The North Park District was occupied by the Ute and Arapaho Indians, according to information furnished by Mr. W. Marr of Hebron, Colorado. As the use of the name Ute would suggest a locality in Utah, it seems to be preferable to name the rang *arapahase* and the subrang *arapahose*.

The mode of the rock can be approximately estimated from the norm, the corundum, hypersthene, olivine and a little anorthite being assumed to enter the pyroxene. The mode would then be about as follows:

Bytownite	25
Augite	15
Iron ores	56
Apatite	4

The mode is, therefore, practically normative. As remarked by Iddings[4] this is "at present the only known example of extruded lava corresponding to the segregated iron ores." It may be pointed out that nearly all such other iron ore rocks are associated with gabbros, those of Kiruna (which are of hematite) being derived from syenites, according to Geijer, and those of Brazil (of which there are no analyses available) being associated with highly sodic, nephelite-rich rocks. The relations of the Colorado rock are too little known as yet for any discussion of its associations.

While the rock would logically be called a magnetite basalt, on account of its extrusive character and mode, yet it is so unique as to occurrence and chemical composition, that a special name seems to be justified. For this that of *arapahite* is suggested.

[4] J. P. Iddings, Igneous Rocks, **2**: 332. 1913.

ABSTRACTS

Authors of scientific papers are requested to see that abstracts, preferably prepared and signed by themselves, are forwarded promptly to the editors. Each of the scientific bureaus in Washington has a representative authorized to forward such material to this journal and abstracts of official publications should be transmitted thru the representative of the bureau in which they originate. The abstracts should conform in length and general style to those appearing in this issue.

PHYSICS.—*Latent heat of fusion of ice.* H. C. DICKINSON, D. R. HARPER, and N. S. OSBORNE. Bulletin, Bureau of Standards. In Press.

Of the two experimental methods employed, one is the well known method of mixtures in which an ice sample of from 100 to 200 grams weight was allowed to melt in the calorimeter, cooling the water. The other was an electrical method of somewhat higher precision. An ice sample 500 grams in weight was put directly into the water and the approximate amount of energy required to melt the ice supplied electrically and measured, the small excess or deficiency being determined from the small rise or fall of temperature of the calorimeter. The usual calorimetric cooling correction was thus rendered relatively very small and the heat capacity of the calorimeter needed to be known only approximately. The ice specimens used were from commercial plate, can, and natural ice, and from ice frozen in the laboratory from double distilled water both free from air, and containing air. They were cut in the form of hollow cylinders to secure a more uniform rate of melting. The samples were kept at the uniform temperature of either $-0°.72$ or $-3°.78$ for several hours previous to the experiments, and were so weighed and handled as to introduce each into the calorimeter at the selected constant temperature with no significant error. The heat of fusion of each of 92 samples of pure ice was determined by one of the two methods. The results of the first half of these observations, made before the best experimental conditions were secured, indicate no differences between the heats of fusion of the different kinds of ice greater than the limits of precision, that is, about one part in a thousand. The latter half show no difference as great as one part in five thousand between the commercial kinds of ice. The final figure for the heat of fusion of pure ice is 79.63 cal_{15} per gram mass.

H. C. D.

GEOLOGY.—*The enrichment of sulfide ores.* W. H. EMMONS. Bulletin U. S. Geological Survey No. 529, pp. 252. 1913.

The theory of sulfide enrichment is stated as follows:

No metallic sulfide that is long exposed to air and water remains unaltered. Iron sulfides, which are present in practically all sulfide ores, are changed by weathering to iron oxides, and the changes are attended by the liberation of sulfuric acid. Many of the metals form soluble sulfates with sulfuric acid, and when conditions favor their migration downward they are carried in solution to depths where air is excluded. Unoxidized rocks are in general alkaline. Acid solutions that encounter such rocks in the regions where air is excluded will lose acidity, and as the solutions approach a neutral or alkaline condition some of the metals they contain are deposited. If the solutions of the metallic sulfates encounter metallic sulfides in depth precipitation may take place, or there may be an interchange between the metals in solution as sulfates and the metallic sulfides. Thus as a result of precipitation or chemical interchange the metals are redeposited and certain portions of the ore bodies become enriched.

The effects of physical conditions on the process of enrichment are discussed and the chemistry of the process is approached from both the experimental and the theoretical side, the chemical relations of minerals of copper, silver, gold, lead, zinc, and iron being discussed in turn.

The literature of the principal deposits of copper, gold, and silver sulfide ores in North America is reviewed with special reference to the extent, character, and distribution of the secondary ores in each. Of copper deposits with deeply enriched zones none are known to carry pyrrhotite or abundant sphalerite. The data indicate that, in general, ores containing abundant pyrrhotite and sphalerite become more thoroly oxidized than those containing pyrite and chalcopyrite without pyrrhotite or sphalerite; but oxidation and enrichment are not likely to extend as deep in pyrrhotite or sphalerite ores.

Many auriferous deposits in the surficial zone appear not to have been enriched by secondary agencies, while in others there is no evidence of solution and re-precipitation of gold. It is concluded that the solution of gold depends in the main on the presence, simultaneously, of manganese and chlorides. Its migration depends on the permeability of the lodes and the material of the primary ores. Of the common minerals calcite and pyrrhotite will probably precipitate gold from auriferous solutions most rapidly. All the districts of silver-gold deposits in which gold is assumed to have migrated include manganiferous ores. In deposits carrying both metals, especially where chlor-

ides form, secondary silver minerals are likely to be precipitated as bonanzas near the surface, while gold may be carried to greater depths. Abundant pyrrhotite in the primary ore quickly halts the downward migration of both silver and gold. SIDNEY PAIGE.

GEOLOGY.—*Kenova, Ky., West Virginia and Ohio, folio.* W. C. PHALEN. Geologic Atlas of the United States, Folio 184, page 16; with maps and sections, U. S. Geological Survey. 1912.

The rocks exposed include both the igneous and sedimentary classes. The igneous rocks are peridotite dikes which cover a small area in the western part of the quadrangle and are of interest in having been prospected for diamonds. The sedimentary rocks belong in the Carboniferous and Quaternary systems. The former system includes both the Mississippian and Pennsylvanian series. Included in the Mississippian are the Logan Formation and the Maxville Limestone. In the Pennsylvanian are included the Pottsville, Allegheny, Conemaugh and Monongahela formations. Pleistocene and Recent deposits constitute the Quaternary system.

Tho no part of the quadrangle lies within the glaciated region, it contains deposits of Pleistocene age. These are the low and high level river gravels along the Ohio and Big Sandy Rivers and back of the city of Ashland, in a district known as the "Flatwoods." They were formed by rivers that abandoned their former courses as a result of the invasion of the neighboring region by ice.

The asymmetry of the drainage is probably dependent both on present structure and the character of the rocks which are mainly sandstones, sandy shales and shales. Excepting the shales, the rocks are water-bearing and produce many springs. The underground currents flow more readily with the dip than against it, with the consequent tendency for erosion, both surficial and possibly underground to proceed up the dip. Thus the main streams of the region tend to lengthen those tributaries, which, flowing with the dip, erode more rapidly than those flowing against it, and consequently to push the divides between trunk streams westward on the west side of the synclinal axis and eastward on the east side of this axis. W. C. P.

BOTANY.—*A key to common Nebraska shrubs.* WILLIAM H. LAMB, Forest Service. Forest Club Annual, University of Nebraska **5**. 1913.

This is a key, based on prominent distinctive characteristics that can readily be observed by those who have had no special training in botany, and intended as a guide in the identification of the more common genera of shrubs and woody vines native and original in Nebraska. W. H. L.

ZOOLOGY.—*Descriptions of twenty new recent unstalked crinoids, belonging to the families Antedonidæ and Atelecrinidæ, from the Dutch East Indies.* AUSTIN H. CLARK. Notes from the Leyden Museum, **34**: No. 2, Note XXV. 1912.

The following new species, all collected by the Dutch steamer *Siboga* in the Dutch East Indies, are herein described: *Antedon moluccana, Compsometra iris, Compsometra parviflora, Compsometra longicirra, Compsometra gracilipes, Iridometra* (*Eumetra*) *aphrodite, Iridometra gracilis, Toxometra purpurea, Psathyrometra major, Psathyrometra minima, Psathyrometra inusitata, Psathyrometra anomala, Nanometra clymene, Trichometra delicata, Trichometra brevipes, Thaumatometra alcyon, Thaumatometra thysbe, Atopcrinus* (a new genus of Atelecrinidæ) *sibogæ, Atelecrinus sulcatus* and *Atelecrinus anomalus.* A. H. C.

ENTOMOLOGY.—*Piccole note su degli Onychophora.* AUSTIN H. CLARK. Zoologischer Anzeiger, **42**: 253–255. 1913.

Thru the courtesy of President J. C. Branner of Stanford University, California, and of Prof. J. H. Comstock of Cornell University, Ithaca, New York, the author has been enabled to examine a specimen of *Peripatus* taken by President Branner at Breves, on the island of Marajó at the mouth of the Amazons, in 1882 and recorded by him, under the generic name only, in 1886. It proves to be an example of *Peripatus* (*Epiperipatus*) *simoni* Bouvier.

A specimen received thru Mr. W. E. Broadway from Tobago, British West Indies (a new locality for the group) represents *Peripatus* (*Epiperipatus*) *trinidadensis* Stuhlmann, but appears possibly to indicate a local variety, for which the name *Peripatus* (*Epiperipatus*) *broadwayi* is suggested.

A specimen of *Peripatus* (*Peripatus*) *juanensis* Bouvier is recorded from Vieques, near Porto Rico, and three specimens of *Peripatoides novae-zealandiae* (Hutton) are recorded from New Zealand. A. H. C.

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